Practices on Shiftings, Compressions and Expansions, and Reflections.

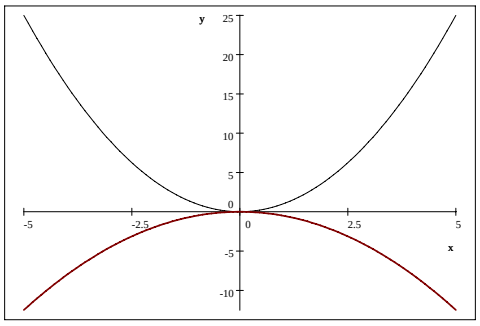
1. Let $f(x) = x^2$.

a. Find the function g (write down the function) so that $y = g(x)$ is a reflection of $y = f(x)$ with respect to the $x - axis$. [answer: $g(x) = -x^2$]

b. Find the function h (write down the function) so that $y = h(x)$ is a shifting of $y = f(x)$ left 30 units and down 30 units.
$h(x) = (x + 30)^2 - 30.$]

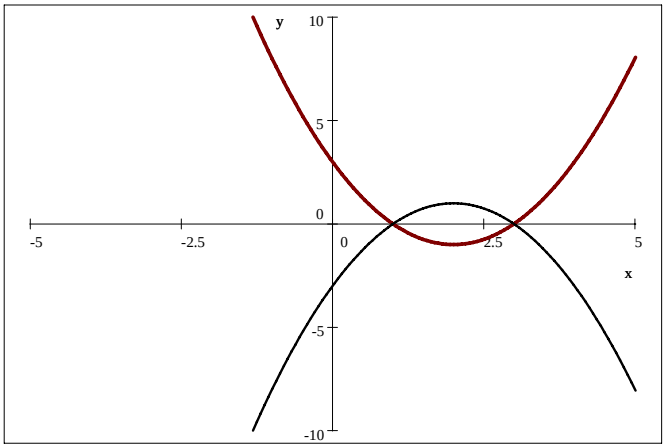
c. Find the function k (write down the function) so that $y = k(x)$ is a shifting of $y = g(x)$ left 30 units and down 30 units. [
$k(x) = -(x + 30)^2 - 30.$]

d. If $l(x) = -\frac{1}{2}x^2$, sketch $y = f(x)$ and $y = l(x)$ together.

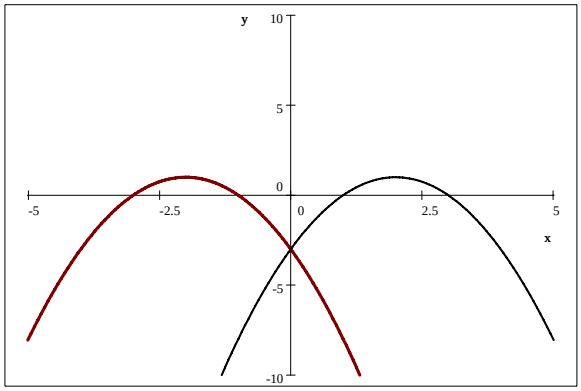


2. If $f(x) = -(x - 1)(x - 3)$

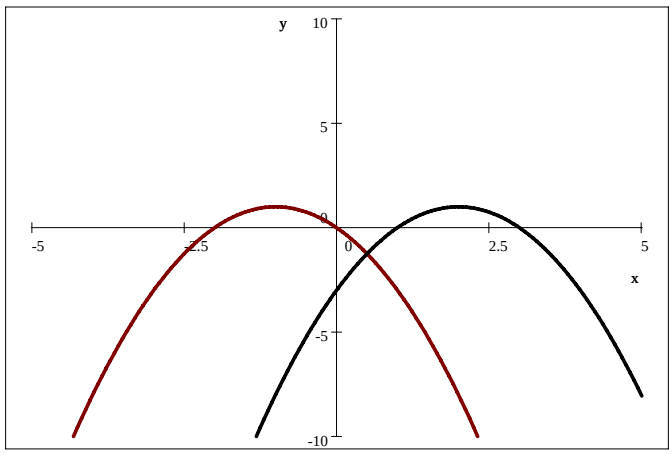
a. Describe the relationship between $y = f(x)$ and $y = -f(x)$. Sketch the graph of $y = -f(x)$.



b. Describe the relationship between $y = f(x)$ and $y = f(-x)$. Sketch the graph of $y = f(-x)$



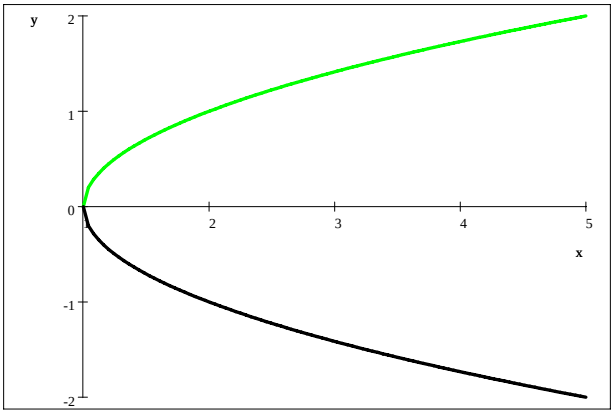
c. Describe the relationship between $y = f(x)$ and $y = f(x+3)$. Sketch the graph of $y = f(x+3)$ [$y = f(x+3)$is being shifted to the left 3 units from $y = f(x)$.]



d. Describe the relationship between $y = f(x)$ and $y = f(x) + 3$. Sketch the graph of $y = f(x) + 3$. [$y = f(x) + 3$ is being shifted up 3 units from $y = f(x)$.]

3. If $f(x) = -\sqrt{x-1}$

a. Describe the relationship between $y = f(x)$ and $y = -f(x)$. Sketch the graph of $y = -f(x)$. [$y = f(x)$ is in black and $y = -f(x)$ is in green].



b. Describe the relationship between $y = f(x)$ and $y = f(-x)$. Sketch the graph of $y = f(-x)$. [$y = f(-x)$ is being refected along $y - axis$ from

$y = f(x)$.

c. Describe the relationship between $y = f(x)$ and $y = f(x - 3)$. Sketch the graph of $y = f(x - 3)$. [$y = f(x - 3)$ is being shifted to the right 3 units from $y = f(x)$.]

d. Describe the relationship between $y = f(x)$ and $y = f(x) - 3$. Sketch the graph of $y = f(x) - 3$. [$y = f(x) - 3$ is being shifted down 3 units from $y = f(x)$.]

e. Describe the relationship between $y = f(x)$ and $y = 2f(x)$. Sketch the graph of $y = 2f(x)$. [$y = f(x)$ is in green and $y = 2f(x)$ is in red].